were hauled downward by persons standing at the apices of a large equilateral triangle (described upon the ground) until the ascending tendency became considerable (even when the force of the wind was at its minimum), and the three cords were made fast to stakes or held in the hand. He had entertained no expectation of the favorable result of this simple and obvious contrivance. The place of the kite did not seem to vary so much as one foot in any direction, and it really appears to him probable that a very large kite or kites might be employed in this kind of manner *often* and very cheaply, as a substitute for a captive balloon in meteorological inquiries, or even (on a very extensive scale) for other requirements in military science, etc. An anemometer, a thermometer, an hygrometer, etc., of some registering kind, etc., might be hauled up and lowered at pleasure (like a flag) by a person standing in the center of the triangle (above referred to), and by means of a line passing through a little block attached to the kite. The cords and kite should of course be of pure silk, for the sake of lightness, combined with extreme strength, and the size and thickness in some measure adapted to the breeze or lighter air. The silk might be advantageously covered with a very light coat of elastic varnish.

With reference to the use of the kite in Belgium, Lancaster says:

About 1880 our late regretted colleague, Fr. Van Rysselberghe whose inventive genius was always on the alert, sought to solve the problem of making meteorological observations at great heights and in free atmosphere by means of kites. He constructed different models of these capable of carrying self-registering apparatus and success seemed about to crown his efforts when he was lured from these studies by a question which was engaging the attention of all investigators, viz, that of telephonic communications at long distances. We know with what ardor he pursued this subject and thus he was lead to completely abandon his kite work.

Among other notes Lancaster states that the so-called Malay kite is a transformation of the Chinese kite, devised by Mr. Millet, of New York City, whose experiments are described in the Aeronautical Annual. The Hargrave kite, so-called after the inventor, Lawrence Hargrave, of Clinton, New South Wales, Australia, is fully described in the successive volumes of the Proceedings of the Philosophical Society at Sydney. A full description is also given by Hargrave in the American Engineer for 1895. This form of kite is generally considered the most perfect of its kind. It has great stability. A kite of one square yard area can raise 6 or 8 pounds of weight. With six kites of two square yards area, 180 pounds can easily be raised from the earth. The total weight of the six kites with the cord would be 35 pounds. It is hardly necessary to say that the lifting force of the kite varies with the velocity of the wind when the surface area of the kite and its angle of inclination remain the same.

The dimensions of the Hargrave kites experimented upon by J. B. Millet, are given by him from the Aeronautical Annual, Boston, 1896, p. 127, and are as follows:

The smallest Hargrave weighed 1½ pounds and had an area slightly less than 9 square feet and would carry a thermograph weighing 3 pounds. A comparative experiment with a Malay kite weighing nearly 1 pound and having a total surface of 85 square feet, during a wind of from 20 to 25 miles per hour showed that the Hargrave kite had a pull of from 6 to 17 pounds, while that of the Malay kite was from 4 to 9 pounds. From this there results for the Hargrave kite a pull of from 7 to 19 pounds per square yard, but for the Malay kite from 6 to 11 pounds per square yard. The angular altitudes of the kites, as seen from the reel, are 45° to 50°.

THE UPPER CURRENTS OF AIR ABOVE THE INDIAN MONSOON REGION.

Mr. W. L. Dallas, of the Meteorological Office at Calcutta, has published an abstract of an elaborate paper in which he discusses all available observations of the wind, and the direction of motion of the cirrus, cirro-stratus, and cirro-cumulus, and, finally, the highest pure cirrus. The observations refer to the Arabian Sea and the Bay of Bengal, and although his detailed tables and text have a local application, yet the following paragraph will be of universal interest:

In so far as we can trust these observations the registration of the movement of the clouds would undoubtedly be helpful in the determination of the movement of the upper currents of air. The author endeavored to bring the observations now under discussion into unison with the theoretical conclusion that there exists an easterly current when the sun is in the zenith, but at all seasons of the year inflowing northeast and southeast winds, at a moderate altitude, and outflowing winds at greater altitudes; but the recorded observations afford no confirmation of such a circulation. He also attempted to explain the upper currents by means of the assumed distribution of pressure over India at 10,000 feet above sea level. So far as one can see from one example it follows that it would be useless to rely upon observations of the motions of the clouds made by occasional observers in order to obtain any correct idea of the circulation of the upper layers of the atmosphere. This is the result of two causes, the first and most important is that in nearly all cases clouds are a phenomenon belonging to a disturbed condition of the atmosphere, and that the observations of their appearances and motions simply define the nature of the disturbances above the point of observation. As an example, the following case may be mentioned. To the north of Simla lie the snow-covered range of the Himalayas, and on clear winter days, which it may be mentioned, are far more numerous than the cloudy days, one may observe the cumulus clouds which are formed above the snow-covered mountains as the result of local evaporation. These clouds rise and move away from the snow-covered mountain tops above which they are formed and move from the mountain chain toward the southeast, thus demonstrating the existence of a current from the northwest toward the southeast at a level of from 20,000 to 25,000 feet above the sea, or 13,000 to 18,000 feet above Simla. This motion occurs uninterruptedly day after day, but suddenly the weather is disturbed; a depression appears on the daily map over Afghanistan and clouds move over Simla from the southeast and east toward northwest and west; if therefore, there were no artistic clouds produced to the north of Simla, such as occur during fine weather, then would the clouds that now come from the southeast be the only ones that are observed, and the natural conclusion would be that at a height of from 20,000 to 25,000 feet there prevails an upper current from the east and the southeast, whereas really this is an exception, and as a rule the current is from the opposite side. This would seem to show that a determination of the normal movement of the upper atmospheric circulation, by means of the ordinary observation of the clouds, is a process of very doubtful value.

Another important point is the classification of the clouds by different observers according to their altitude. In the case of the Indian monsoon region we may assume that there are three different atmospheric motions during the progressive advance of the southwest monsoon, which three movements are partially blended together above any given point. The lowest is the movement from the southwest which prevails from the surface of the ground up to very considerable altitudes and in which are numerous cumulus clouds. Above this the movement from southeast and east prevails; this current corresponds to the southeast trade wind in other tropical regions, but it now appears to belong to the upper atmosphere because of the monsoon below, at the surface of the earth. Finally, we have the return current from the thermal equator toward southern latitudes. Now it is exceedingly improbable that when these three currents exist clouds should be present in all three simultaneously. Consequently we come upon an inevitable confusion when one observer classifies certain clouds in the southeast current and certain others at a different time in the upper return current, as upper clouds in both cases and thus leads astray the investigator who is making the attempt to discuss all observations systematically in the same way.

An unusually careful and painstaking observer who is stationed at one place and desires to develop a theory on the basis of the continued study of the movements, forms, and altitudes of clouds that pass above him, might possibly be able to attain an approximate estimate of the changes of the weather that are now in progress, or even those that are about to happen in his neighborhood; but the author doubts very much whether it will be possible for him to determine the general motion of the air in the upper strata of the atmosphere with the help of the cloud observations that are made by a variety of observers at a variety of places and at very different times.

This is very much to be lamented since such a determination of the approaching weather is perhaps at present the most important demand that is made on meteorology.

THE ORIGIN OF TYPHOONS AND HURRICANES.

The study of the formation and development of cyclones has been followed with the greatest minuteness under exceptionally favorable conditions by the meteorologists of India. In a recent essay (An Account of a Storm Developed in Equatorial Regions, Calcutta, 1896), Mr. W. L. Dallas has endeavered to decide whether the inrush of a saturated stormy wind from the southwest into a region of heated moist air, is essential to, or the determining cause of, the formation of a cyclonic whirl. He finds that it is not necessary and gives in detail the facts of a special case over the Bay of Bengal between the 1st and 15th of December, 1894. His conclusions are favorable to the general correctness of the ideas developed by Professor Ferrel who, as is well known, gave a more precise expression to the principles taught by Espy. According to these meteorologists, when a general uniformity of pressure and quietness prevails in the atmosphere, especially over the ocean, and when the quiet air becomes so warm and moist that ascending currents and clouds are forming here and there over the warm region, then any one of these ascending currents may be so fed with moist air as to steadily increase in its volume and instability; it rises and the surrounding air that is drawn in begins a gyratory motion, usually in the cloud regions, but which is soon propagated downward to the earth's surface. The quiet region in which the instability first occurs is often that which is called the doldrums; if this is not located at the equator, but five or ten degrees north or south, depending on the season, then the gyration of the winds around the center is fully determined by the deflecting action resulting from the diurnal rotation of the earth on its axis.

In summing up the results of his study of this storm Mr. Dallas says:

On the first three days of December, 1894, the Indian daily weather charts exhibited a typical illustration of the ordinary meteorological conditions which theory assigns to the Belt of Calms. An area of continuous low barometer lay over the equator, on either side of which the two trade wind currents blew freshly, while within the area itself, the surface winds were very light and variable. The weather was fine generally, but daily, at 4 p. m., just after the diurnal period of greatest evaporation, heavy precipitation of rain took place. The charts for these days show, then, a more or less inclosed area within which the weather was fine, and constant evaporation was proceeding with apparently no horizontal outlet for the accumulating aqueous vapor. On the 3d of December the southeast trades seemingly began to take off, but the observations on this day show that nearly all the ships in southern latitudes had entered or were close to the inclosed area of light and unsteady winds and low barometer. The sky was densely clouded, and though heavy rain fell for a time during the later hours of the day, this outlet was probably insufficient to stay the steady accumulation of aqueous vapor over the inclosed area. In the afternoon of this day (3d) the vessel *Falls of Garry*, in latitude 5° south, reported the cessation of the southeast trades, their replacement by light, variable, "puffy" breezes and heavy rain. By the 4th the process of accumulation of aqueous vapor had apparently reached its maximum and the subsequent condensation had set in. A continuous downpour of rain was reported, and this was accompanied with light, variable airs and calms on all the ships within the inclosed area. At the same time as the constant rapid condensation proceeded so did atmospheric pressure diminish, so that by the morning of the 6th a well-defined central area of depression had been developed within the inclosed area almost directly over the equator. It is interesting to note that so far as can be judged from the observations, at the period when the process of constant evaporation had resulted in a saturated condition of the atmosphere over the inclosed area, and the subsequent process of sudden, rapid, and extensive condensation had succeeded, there apparently occurred a slight but appreciable rise of pressure over the whole equatorial region under observation. This rise was shown by the chart of 8 a. m. of the 4th (not reprinted), and it will be remembered that it was after 4 p. m. on the 3d that the process of rapid condensation set in and became the most important of the changes in progress over the area.

If the above be the explanation of the initiation of the storm, then further inquiry would be unnecessary, as the principle of evaporation and condensation is a general and not a local one and is as applicable to equatorial regions as to other parts of the earth's surface. Further, it is unnecessary from this point of view to introduce a force to account for the gyratory motions, as the theory presupposes an irregular inflow of the surrounding air as pressure diminishes, an inflow which can only result in a vorticose or spiral motion of the atmosphere converging towards a center, while for the gradual increase in the intensity of the barometric depression and in the force of the winds an adequate cause is assigned in the rapid condensation and precipitation of rain accompanying the inflowing currents of air when once the center is developed. * * * Two minor points of interest connected with the disturbance deserve perhaps passing notice. The first is the torrential rain which accompanied the disturbance throughout its course. This rainfall was apparently associated with a stream of air from transequatorial regions, and as soon as this supply was cut off and the wind shifted to northeast again, to the south of the disturbance the rainfall decreased and the intensity of the disturbance diminished. The second is the sharply defined limits of the disturbance. Hardly any indication of the presence of a storm was afforded by the coast observations. So much so indeed was this the case that the rainfall which occurred around the head of the Bay on the 14th and 15th when the center of disturbance was in latitude 18° and 20° N was ascribed to disturbed weather in Upper India instead of its actual source, viz, the depression over the Bay.

THE LOW AREAS ON OUR PACIFIC COAST.

The daily chart for the Northern Hemisphere accompanying the Bulletin of International Simultaneous Meteorological Observations, 1875–1887, has long since familiarized the student with the fact that areas of low pressure frequently pursue very long paths for many consecutive days, in their circuit around the north temperate regions. Those that start in the equatorial portions of the Atlantic or Pacific, after passing northwest and curving to the northeast, finally move east-northeastward between the forty-fifth and sixty-fifth parallels. Others start in the temperate regions, and, without moving to the westward or recurving, pursue nearly the whole path in an east-northeast direction. In describing the history of areas of low pressure the authors who have contributed these chapters to the successive MONTHLY WEATHER REVIEWS for nearly twenty-five years past have usually kept in mind the fact that lows which first appear in Washington, Oregon, Montana, and Alberta, or British Columbia, have probably originated at some point far to the west, and if occasionally the description of such a storm begins by speaking of it as originating over our North Pacific Slope Region, this is a slip of the pen which the reader may generally interpret without being misled by it.

The Editor has on several occasions pointed out the fact that the isobars and therefore the winds at a considerable distance above the earth's surface have very little resemblance to the isobars and winds at sea level. In fact, the normal isobars at an elevation of 5,000 meters (which represents a surface a little above the summits of the Rocky Mountains) present a grand oval depression whose longest axis extends from the United States toward the north-northwest over the Saskatchawan and the Arctic regions to eastern Siberia. (See Chart VII, herewith.) By studying a polar projection of the Northern Hemisphere we perceive that the whole upper circulation of winds and clouds and the general movement of areas of low pressure and high pressure are related to this distribution of pressure in the upper layers of air. When a storm center moves from Japan to the North Pacific, or from the latter to our Pacific Coast, or from Alberta and Oregon southeastward, or from Texas and Kansas northeastward, it is describing some portion of a circuit about this great upper region of low pressure. It is simply a special whirl gliding about in the maelstrom that occupies one-half of the northern hemisphere. The axis of this oval polar maelstrom probably changes its position with considerable regularity, oscillating slowly to and fro; therefore, the paths which the smaller disturbances describe will vary simultaneously with that; sometimes the storms will move far to the south either in America or in Russia in order to circumnavigate the southern extension of the longer axis of the oval but will thereby diminish in intensity and almost die out. Sometimes a new whirl will start at the southern end of the oval; sometimes all the paths of the low areas will lie on the northern border of the United States and Canadian weather charts because the polar maelstrom has altered its dimensions and locations. Even the great subpermanent areas of low pressure in the North Atlantic and North Pacific are subordinate to the greater area of low pressure at the upper level and its attendant winds.

These remarks are appropriate to a note from Mr. Alexander McAdie, local Forecast Official at San Francisco, in which he says: